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In vivo evaluation of the biodistribution and safety of PLGA nanoparticles as drug delivery systems

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Abstract

The remarkable physicochemical properties of particles in the nanometer range have been proven to address many challenges in the field of science. However, the possible toxic effects of these particles have raised some concerns. The aim of this article is to evaluate the effects of poly(lactide-co-glycolide) (PLGA) nanoparticles in vitro and in vivo compared to industrial nanoparticles of a similar size range such as zinc oxide, ferrous oxide, and fumed silica. An in vitro cytotoxicity study was conducted to assess the cell viability following exposure to PLGA nanoparticles. Viability was determined by means of a WST assay, wherein cell viability of greater than 75% was observed for both PLGA and amorphous fumed silica particles and ferrous oxide, but was significantly reduced for zinc oxide particles. In vivo toxicity assays were performed via histopathological evaluation, and no specific anatomical pathological changes or tissue damage was observed in the tissues of Balb/C mice. The extent of tissue distribution and retention following oral administration of PLGA particles was analyzed for 7 days. After 7 days, the particles remained detectable in the brain, heart, kidney, liver, lungs, and spleen. The results show that a mean percentage (40.04%) of the particles were localized in the liver, 25.97% in the kidney, and 12.86% in the brain. The lowest percentage was observed in the spleen. Thus, based on these assays, it can be concluded that the toxic effects observed with various industrial nanoparticles will not be observed with particles made of synthetic polymers such as PLGA when applied in the field of nanomedicine. Furthermore, the biodistribution of the particles warrants surface modification of the particles to avoid higher particle localization in the liver.

From the Clinical Editor

The aim of this study was to evaluate the effects of poly(lactide-co-glycolide) (PLGA) nanoparticles in vitro and in vivo compared to industrial nanoparticles including zinc oxide, ferrous oxide, and fumed silica. The authors concluded that the toxic effects observed with various industrial nanoparticles is unlikely to be observed with particles made of PLGA. The biodistribution of these particles warrants surface modification to avoid particle accumulation in the liver.

Keywords

Nanoparticles; Nanomedicine; PLGA; Biodistribution; Toxicity